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ABSTRACT

Information highways are high speed data networks used to transport information and link people together. As more limitations of and problems with the information highway ("potholes") become apparent, the highway metaphor may have to be revisited, and the information highway must be examined with a critical eye. Distance educators confront much fast-paced activity and hype in the use of conferencing technologies (CTs) and have to choose among them. Technologies such as audio, audio graphic, video, and computer conferencing are explored with respect to concepts, new knowledge, and guides to decision-making. Four key areas are selected for metaphorical and analytical thinking about CTs: (1) mass media and its biased presentation of information and its inflexibility of use; (2) constructivist learning theory and its focus on creativity, multiplicity, and growth, and learners' use of CTs; (3) adult characteristics and how they help or hinder learning; and (4) gender issues, especially the existing learning skills and preferences of women. Educators appear to be using the technologies to carry out much the same activities as within traditional classrooms, but with more efficiency. In exploring new CTs and their use, the challenge is to develop collaborative styles of learning and to change teaching functions without reducing academic rigor and the teacher's sense of importance. Educators must ask the why and when questions of CT use to determine appropriateness before asking how. Contains 58 references. (MAS)

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Electronic highway or weaving loom? Thinking about conferencing technologies for learning.

by Elizabeth J. Burge

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Electronic highway or weaving loom? Thinking about conferencing technologies for learning.

Liz Burge*

Information highways are high speed data networks used to transport information and link people who want to be connected with others. E-mail, bulletin boards and computer conferencing are common activities on the Internet and other electronic networks. The metaphor of a highway is used to reflect qualities of speed, volume, power and efficiency (Menzies, 1994a, p.7). Any decontextualized look at a real highway shows how we may travel efficiently without too many interruptions and delays. However, a contextualized look at highways, as they operate in the natural environment, suggests some limits in the usefulness of the metaphor for learning contexts. The highway is a rigid metal and asphalt ribbon imposed on the countryside and it enables large quantities of fast moving traffic to travel as single, unrelated units using laws to regulate traffic flow.

In the early stages of electronic data networks the highway metaphor attracted much attention, but now, as "potholes" and "roadkill" become evident, users react more cautiously.

> Is the information Highway the road to a common future or just another trip to the mall?" (Menzies, 1994b, p.3).
>
> Internet is more than a highway; it's a virtual community where multiple things happen (de Boer, 1994).

*I acknowledge the research help given by Judith Murphy, Janet von Weiler and Daniel Yakimchuk for background in parts of this paper.

> Time will tell whether the benefits triumph over the difficulties and allow computer conferencing to make a significant contribution to distance education (Mason, 1990, p.226).

> Computer conferencing is like riding the rapids, you've got to get in a boat and you've gotta keep going--you have to keep that boat moving along the river of information, because if you ever stop you're going to go down (Burge, 1994, p.32).

When such reactions illustrate the limitations of high speed, high volume "traffic," what do we do with the highway metaphor? One solution is to jettison it altogether and develop others. One metaphor raises very different associations: one of lower speeds and volumes of activities, and creative activity:

> ... computer mediated communication is like a loom. The threads of experience each participant brings to the loom form the warp and weft of the fabric of learning. The weaver first threads the warp threads on the loom, determining the overall pattern of the cloth. The course planner threads the education loom with warp threads of course outline and plan. With warp threads in place, weft threads are added. Qualities of the threads used affect the design decisions and the pattern of final woven fabric. The weft threads of the educational loom are spun by the life experiences of all participants, each with a different texture. Every weft thread added to the cloth causes it to change and grow. As each learner contributes a thread of discussion to the learning experience, the cloth of learning is formed (von Weiler, 1994).

This metaphor helps my understanding of interactive learning. But what am I to do with these very different metaphors of highway and loom? Do I choose between them, or change my perspectives (Menzies, 1994a)? How flexible and creative is my thinking for that task? Barker's prophecy may apply here (note how it relates to the highway metaphor):

> I believe the next few years are going to be filled with people coming around blind curves and yelling things at you. If you have paradigm *flexibility*, then what they are yelling will be opportunities. If you have paradigm *paralysis*, then what they will be yelling at you will be threatening. The choice will be up to you. (Kemp, 1991, p. 18.)

Will my behaviour show paradigm paralysis, flexibility, or compromise? What kind of paradigm is needed (Jonassen, 1991)?

Distance educators confront much fast-paced activity and hype in the use of conferencing technologies (CT's). We continuously have to make choices, using the lens of informed critique. Postman sees this process as negotiation:

> ...every culture must negotiate with technology, whether it does so intelligently or not. A bargain is struck in which technology giveth and technology taketh away. The wise know this well, and are rarely impressed by dramatic technological changes... (Postman, 1992, p.5).

Which knowledge and values inform our negotiation? How do we understand technology in its natural contexts of use? Before we decide how to respond to the latest billboards on the highway, or change the weaving threads, we have to examine a variety of paradigms (Hlynka, 1991), including our own. The rest of this chapter, therefore, reflects my selection of paradigm components that are key for metaphorical and analytical thinking about CT's. The exploration will cover a variegated landscape: a forest of concepts, some sunlight of new knowledge about CT's, and trails to guide our travel. The technologies are audio, audio graphic, video and computer conferencing; formats that enable synchronous and asynchronous group communications, and which I have used personally. The exploration will avoid extensive reviews of practice because the literature on CT's is still emerging (e.g., Burge, 1994; Burge & Roberts, 1993; George, 1990; Harasim, 1990; Hiltz, 1994; Kaye, 1992; Laurillard, 1993; Macdonald, 1994; Mason, 1994; Wells, 1992). Consequent development of practice will be informed by references to concepts and strategies developed by colleagues in other fields. The forest of ideas has four key areas--media research, constructivist learning

theory, adult learning and gender issues.

Media researchers continue to debate the usefulness of research that depends on objectivity, causality principles and the analysis of selected components of the learning context (e.g., Ullmer, 1994). Hooper and Hanafin (1991) explain their findings carefully:

> ...unique causal relationships between technology and learning have not been established conclusively...the effectiveness of IT [instructional technology] is more likely contingent upon the informed application of time-tested learning strategies than the technological capabilities of a medium (Hooper & Hanafin, 1991, p. 69-70).

Clark and Kozma continue to exchange opinions about research into the effect of media attributes. Clark argues that media do not in themselves cause learning; they act only as delivery vehicles. Media attributes may affect the "cost or speed of learning but only the use of adequate instructional methods will influence learning " (Clark, 1994, p. 27). Kozma supports the new, systemic paradigm in educational research, i.e., seeing how every component in a dynamic system operates and influences each another in naturally complex and unpredictable settings. He argues therefore for media research that looks at situation-specifically strategic use of learning media:

> In what ways can we use the capabilities of media to influence learning for particular students, tasks, and situations? (Kozma, 1994, p. 18).

Jonassen, Campbell and Davidson (1994) respond to Clark and Kozma by emphasizing the unpredictable complexity in learning contexts and the futility of analysing only selected components in a system:

> We delude ourselves when we manipulate attributes of the medium and expect these manipulations to have a predictable effect on a process as complex as

> learning. We certainly cannot know which affordances (to use Clark's terms) are "necessary" let alone "sufficient" causes for learning (Jonassen, Campbell & Davidson, 1994, p. 25).

What are we to make of these expert debates? How do we negotiate our own trails through the thickets of conflicting opinions? We do know that the features of a medium bias how information is represented. Representation often reduces the amount of information available for cognition, reflects the producer's own mindset about knowledge processing, and creates media-induced forms of thinking (Johnson & Johnson, 1993). The medium acts as both message and massage (Menzies, 1994a, p. 8). Norton adds another explanation:

> To represent ideas with speech is to give primacy to memory, rhythm, personalistic and vivid imagery... To represent ideas with print is to give primacy to the analytical, the sequential, the propositional, the hierarchical, and the rational...To represent ideas visually through photograph, television, or film is to give primacy to the presentational, the emotive, the non-rational, and the subjective...(Norton, 1992, p.38).

Given these effects, how might we visualize and differentiate the functions of CT's?. CT's may be experienced, for example, as tools that "give." They are synomorphic when they fit into natural human behaviour, e.g., a glove is synomorphic to a hand, but not to a foot (Knuth & Cunningham, 1993). Draper defines the kinds of tools needed for learning:

> In asking what computers can do to support education, we must not look to large machines or even tools in the traditional sense, but to devices like gloves that fit human ability much more intimately by complementing it. Their essential advantage however is analogous to that of tools: to extend the range that can be brought within the scope of personal interaction--of action but especially of perception. (Draper, 1992, p.170).

One example is the fax machine when it enables fast and reliable transmission of handwritten material produced by learning groups. Another example is e-mail, where time, location, flexibility and speed of transmission make message sending convenient (the highway enables

traffic to flow smoothly).

CT's may be experienced also as tools that "taketh away." For example, in as well as biasing the presentation of information, they can amplify the impact of unhelpful interpersonal behaviours, as in an audio-conferenced student discussion where certain vocal interaction patterns can reinforce dominance and plays for "air power", or vocal qualities such as monotones, nasality or tension can diminish vocal attractiveness and vocal maturity, and hence reduce attention to the listener (Pittam, 1994). One problem with learners' use of CT's is what I term the mitten effect -- reduction of flexibility in use. Learners do not feel or think that the technology helps them to learn in their preferred styles. One classic example of this restriction effect is the audio-conferenced class in which the teacher lectures for 80% of the time, or acts as an all-controlling "traffic cop" of discussions. What should happen is more natural behaviour: learners talking across the teacher to each other and the teacher consciously timing her/his contributions so that they help as and when necessary. Such a dialogue model, however, depends on the learners coming to class having worked already with the information delivered; then valuable class time is spent working at higher cognitive and affective levels.

The second forest area is the renewed interest in the learning theory of constructivism (Brown, Collins & Duguid, 1988; Collins, 1991; Duffy & Jonassen, 1992; Duffy, Lowyck & Jonassen, 1993; Jonassen, 1991; Lebow, 1993; Merrill, 1991; Shuell, 1988; Winn, 1990). Constructivism links with the weaving loom metaphor rather than with the highway metaphor because of its focus on creativity, multiplicity and growth.

> Constructivism, like objectivism, holds that there is a real world that we experience. However, [constructivists argue] that meaning is imposed on the world by us, rather than existing in the world independently of us. There are many ways to structure the

> world, and there are many meanings or perspectives for any event or concept. (Duffy & Jonassen, 1992, p.3).

Constructivist learning is about the elaboration of concepts, but as they operate in real contexts. Learners elaborate (Reigeluth, 1983) via questioning, critique, application, reflection-on-action. Thinking is done interactively and iteratively, as in cross-country skiing across the intellectual landscape. Discussions about constructive learning and teaching are sprinkled with terms that reflect the work in learning, e.g., cognitive apprenticeship (Collins, Brown & Newman, 1989), cognitive load (Chandler & Zweller, 1991), cognitive ergonomics (Zucchermaglio, 1993), and cognitive flexibility (Spiro, et al, 1991).

To learn constructively is to actively process new information, use structured experiential activity and analyses of life experiences, solve problems, examine critically one's existing mental frameworks, accept ambiguities in knowledge, explore belief systems and assess one's learning. The learner's existing mental framework and learning needs are the key agents in interpretation and construction of knowledge. She/he knows that there is no single "truth" in interpretative contexts.

To teach constructively is to provide opportunities for complex information processing related to a learner's needs and knowledge of the world, design relevant and real world (authentic) tasks, help to identify conflicting ideas and attitudes, provide complex and controversial stimuli, challenge the learner's existing knowledge structures and values, acknowledge vague structures in knowledge, help learners revisit material in greater depths, confirm the learning identified by learners, and guide learners to generate correct solutions. Teaching constructively also means skilful attention to learning strategies, not just the content. It means, for example, managing structured tasks for groups, helping learners acquire and use

learning skills, not "rescuing" learners as they experiment with sharing responsibility for class process, and ensuring emotional safety for expressions of need, trust, and uncertainty. Avoided at all costs is the reinforcement of passive dependency in learners and also signs of both cognitive oversimplification and lack of transfer of knowledge from one context to another.

Applying constructivist thinking to how learners' use of CT's means asking first the "why and when for what?" questions before asking the "how" questions. The "when" question is especially important for CT use: it relates to controlling the timing of our interventions in learning processes and our mixing of the contextual elements that affect those processes. The "what" and "why" questions are linked--learning outcomes and learning strategies have to be integrated, but not in ways that deny choices for the learner. Balancing the amount of freedom available within a sense of structure is a key challenge. Another, and one which is the biggest challenge for many teachers using CT's, is to move out of the lecture mode and into facilitative models.

The third forest area contains issues of adulthood. Deserving of more space than is available here, adult characteristics -- as they help and hinder learning -- need some new angles of analysis, especially away from medical models and towards client-centred models. We could further examine our assumptions behind such terms as student support, autonomous learners, and self discipline. Adults do not want to realize they are guinea pigs for clumsy experimental usage of CT's, nor do they want to feel as if asking for help (a deficit model) is the only reason to "talk" in CT mode.

The fourth forest area is heavily populated -- by women distance students. A growing literature (e.g., May, 1994; Kirkup & von Prummer, 1990), recognizes many women's

existing learning skills and preferences, especially collaborative and expressive ones, which are brought to any learning contexts (e.g., MacKeracher, 1993). Women do not need to be told about cooperation and respectful climates; their gender socialization has been strong and they need the freedom to use those skills with confidence. Research into technology equity and use indicates cultural issues (Bush, 1983) and many women bringing expectations of easy efficiency and little patience with unfriendly software (Kantrowitz, 1994; Tannen, 1994).

Where is the sunlight in our landscape? What do we know so far about learner use of CT's? A recent analysis of articles (Murphy, 1994) suggests relatively fragmented, linear descriptions, with little evidence of interdisciplinary theoretical links to actual practice. Examples could include linking research in audioconferenced learning groups to theories on voice perception and its relationship to social identity (Pittam, 1994), applying constructivist learning strategies to computer conferenced learning contexts, or the deliberate design of controversy into CT use (Davie & Inskip, 1993; Davidson & Worsham, 1992).

We appear to be using the technologies to produce amplificatory impacts--i.e., carrying out much the same kind of activity that we have in walled classrooms but with more efficiency (Kiesler, 1992). This means that both the lecture models and dialogical models of teaching are being tried.

We know some principles for promoting relational ways of learning (MacKeracher, 1993). The principles suggest that CT's have to mediate people, not distance. CT's can help to reduce interpersonal conditions that impede productive talk. In CT use we can help learners to share responsibility for class process and also to act as cognitive screens or sieves that sort out and clarify the thinking of their peers.

Effective CT use recognizes that a learner's idea of the effort required to learn from a particular medium will influence her/his cognitive work in processing the information delivered by that medium (Cennamo, 1993). Time is needed for learners to adjust their neurological processing of information to adapt to the particular skills demanded by the medium (Simpson, 1994). The two-way talk of CT's are designed for receiving, processing and sending messages in ways that facilitate active learning, e.g., talking in order to think or to arrive at a tentative conclusion). To use CT's as a vehicle for one-way transmission of pre-digested information, or perfunctory summaries of student work, or for students asking only for help, is a waste of the technologies, especially given the costs. Evidence of cognitive synchronicity (my term for everyone being "connected" to the topic at hand) and social energy for learning are key criteria for effective use. A third criterium is enabling learners to exercise creativity in thought and peer interaction (Post, 1994).

We know that careful attention has to be paid to the affective elements of the environment, e.g., vocal presence, eye gaze, acoustic courtesies, tactful phrasing of written text, visual presence and a comfortable, energized climate. In my experience since 1982 of audioconferenced events (as teacher, chairperson and participant), for example, I've learned that novices have to be helped to understand the benefits and duties of collaborative learning, and many have to learn expression skills in order to think aloud effectively. I've learned too that many people have little or no self-awareness of their vocal presence, and how to use it effectively for group-based talk. I know also that some participants need time and listening space before they speak.

How do we identify effective use of each CT? Audio conferenced classes (AC) can

show evidence of learners referring to each other by name, and doing so across the tutors without fear that their dialogue will be interrupted, working in small groups or tasks before reporting back to the whole, hearing critically constructive feedback from a designated respondent group, venting their frustrations, getting substantive but appropriately timed input from their tutors or teacher, and paying respectful attention to the practical knowledge of their peers. We know that learners' use of AC is enhanced when the teacher uses 6 "C's"--connect learners to resources, create the climate, confirm new learnings, challenge to greater understanding, correct misunderstandings and change the agenda as necessary (Burge & Roberts, 1993, p. 13). The absence of visual cues means that students at local sites can feel "liberated" to engage in dysfunctional group behaviour--all without the teacher ever knowing, unless she/he knows to ask directly, or to have the learners complete assessments of their group process.

Use of text-based computer conferencing (CC), with its lack of vocal cues and strength in text format and relative ease of sending messages to peers, depends on relationship building and focused contributions. Focused messaging is essential, not only to help maintain cognitive synchronicity, but also to avoid information overload and the effect of fragmented thinking. As people contribute at their convenience, the threads of discussion may appear split at the ends and disentangled because the topic of one contribution can appear on the screen after a contribution 30 seconds earlier that referred to quite another thread in the same discussion. Contributing into a 24 hour, seven days a week classroom has its demands:

> ...it's asynchronous, but it's not atemporal; you can't be out of step with [class discussion]...it doesn't mean that time is not important. There is a time factor, a window within which you have to be involved (Burge, 1994, p. 31).

Grint's (1992) perspective on the quality of contribution challenge is relevant: we have to create the conditions for creative "volatibility of conversation" without producing prattle, or what one Open University (UK) student called "chewing gum for the eyes". CC enables much contributive energy (my term) for people to talk as often as they like; when they like, but one person's freedom to write is another's deluge of information (trying to drink a glass of water from a fire hydrant). Learners' use of this medium is enhanced when the teacher enables adequate time for preparation of learners, and provides efficient trouble shooting for technical problems. In other words, render the medium as transparent as possible so that the learner feels efficient and not loaded with perceptions that she/he has to make a huge effort. The paradox of elegance applies here: expert performance appears effortless. Preparation for CC includes showing learners how to direct contributions to relevant conferences so that jumbled and fragmented messaging is reduced. In addition to using strategies listed already for AC, the CC teacher has to keep a keen eye on cognitive synchronicity and contributive energy.

Video conferencing (VC) poses a particular challenge because its visual element tends to encourage recidivism into lecturing modes. Educators are finding ways to use the somewhat limited visual channel to enhance the cues necessary for communicating ideas and understanding the feelings behind the expression. Text and pictures can be transmitted relatively easily using cameras but their function has to support the talk and their legibility maximized. Creating social presence means that learners have to be taught to look directly at the camera in order to be present metaphorically with their peers in another site. Any impersonal styles reduce psychological connection. Participants need also to acquire visual composition skills to avoid the screen being filled with empty table tops, cluttered

backgrounds and distant faces.

Audio graphics (AG) also pose challenges in visual composition for the expression of ideas. AG enables real-time talking by AC and the use of pre-prepared and on-line, ad hoc information, so the teacher is integrating two channels of information. The temptation is to use the computer screen as a blackboard that transmits everything, even information that could be more efficiently delivered in paper format. Adult learners will not easily tolerate uninformed use of CT's by people seduced by the medium. Because of the voice and visual links, attention has to be paid to the correspondence of information presented, i.e., visuals and spoken words have to work together without undue redundancy.

Having seen the forest and felt the sunlight, how am I guided to travel on new CT trails? One strategy is to explore the links between the structural elements of learning (the loom) and the process elements (the threads and the weaver). For example, in audio conferencing, three structural elements are participants, synchronous vocal communication, and no visual cues. Learning tasks such as being attentive, generating ideas, elaborating concepts and getting feedback are enhanced when the teacher talks less and listens-to-respond more than she/he may do using a lecture mode. The challenge therefore is to change teaching functions without reducing academic rigour and the teacher's sense of importance. Adult learning facilitators already have those insights. With each CT, collaborative styles of learning will be designed quite deliberately; it does not happen just because people have been collected together. This connection issue relates to the synergy of learning:

> ...creating a shared experience of learning is qualitatively different from helping individuals share their prior experience (Johnson & Johnson (1993, p. 146).

Another trail strategy is to think functionally--about gloves and tools, not mittens and weapons. Redefine ideas about control and empowerment that swirl around the CT's: from meaning access to fire-hydrant quantities of information and unlimited opportunities for one-to-many opinion-giving to meaning the selection of glassfuls of information and the creation of community contexts for critically examining that information. Provide opportunities for learners to talk in order to help their thinking, rather than always the reverse process. Connect a functioning group; don't just collect an aggregate of bodies. This last goal means thinking about holistic learning. Consider Heather Menzies' warning: avoid education being "increasingly transformed into educational packages...and [being] less and less a holistic experience in real life, grounded in real communities" (Menzies, 1994b, p. 12.) Examine each emerging CT first for how it helps learning, and how its use can be sustained. Identify our own metaphor for the CT's, for in such descriptions do we display our professional paradigm and avoid paradigm paralysis. Finally, ask about our key goals for CT use; are they technological mastery of CT's -- functional skills, or conceptual mastery -- asking the why and the when questions before the how questions. When integrated into the whole learning context, as one component among many, conferencing technologies offer learners and educators flexible ways to connect with one another, not surpass one another.

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